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A BACTERIAL CANKER OF PLUM TWIGS

By I. M. Lewis

A disease of plum trees popularly known among growers as canker was first called to my attention during the summer of 1910. Since that time it has been kept under observation and has been found to be one of the most prevalent and serious diseases of the plum which occurs in this area. It was first reported from this locality by Heald[1] and Wolf in their report of the diseases prevalent in the vicinity of San Antonio, Texas, and a brief description of the symptoms was here given. These writers made collections in several different orchards and reported it to be the cause of much damage. The same disease had been previously recorded by Heald[2] in 1905 from Nebraska. A similar and perhaps identical disease was reported from Delaware in 1905 by Jackson[3], and the statement made that it causes considerable damage to the plum orchards in that section of the country. These reports were all based upon incomplete studies but agree very well in the description of the symptoms, the seriousness of the disease, and the probable bacterial origin of it. A careful search through the literature failed to reveal more information concerning this canker than is contained in the notes cited above. It seemed therefore, that in view of its widespread distribution and unknown etiology, a careful study including cultural work and inoculations should be carried out. Accordingly at the beginning of the present season such a study was undertaken.

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[1] Heald F. D. and Wolf F. A. A Plant disease survey in the vicinity of San Antonio, Texas. Bulletin U. S. Department of Agriculture, Bureau of Plant Industry, 226:32. 1912.

[2] Heald, F. D. Annual Report of the Nebraska Agricultural Experiment Station, 19:32-33. 1905.

[3] Jackson, H. S. Bacteriosis of plums. Annual Report of the Delaware Agricultural Experiment Station, 18:75-76. 1905.

SYMPTOMS

The first visible indication of a young canker is the appearance upon the wood of the first season's growth of a small water-soaked spot surrounding a lenticel. Such a spot enlarges rather slowly and the tissue immediately surrounding the lenticel becomes slightly bulged outward due to the great numbers of bacteria which have multiplied in the underlying tissue. As the spots increase in size, they soon became much longer than wide, frequently reaching a length of one to three centimeters. The twig may be completely girdled but this is not generally the case. In the majority of the cankers about one-half the diameter of the twig is involved. The infected areas always become more or less sunken with age and the color changes to a purplish black with a transluctent border. It frequently happens that several of these areas become confluent, producing a very much elongated area, and one which encircles the twig completely and kills it.

These sunken areas, show in cross section, a number of radial rifts or cavities extending outward in the young wood and cortex to just below the epidermis. As the twig increases in size, these rifts open to the outside, forming a medium longitudinal fissure. The cankered tissue contains great numbers of bacteria which may be frequently seen to form a bacterial ooze. The new cankers never appear upon any of the wood except that of the first season's growth. Twigs have been observed upon which a dozen cankers were present in different stages of development. These Cankers do not generally become healed over but persist on the twigs of the second and succeeding seasons as open perennial cankers.

When once a tree has become invaded, and the diseased branches permitted to remain in the tree, it would require the most drastic pruning to remove all of the diseased wood. In many cases the tree is so badly damaged as to render its complete removal advisable. The older branches shown in the accompanying plate are six years old.

THE CAUSAL ORGANISM

The organism which causes the disease is readily isolated from the underlying wood and cortex of young unopened cankers. Such tissue was removed by means of a sterile scalpel, placed on a sterile glass slide in a few drops of bullion, and teased apart so as to secure a suspension of the bacteria. Dilutions were made from this into plain agar in the usual way and series of plates poured. Several such isolations were made. In every case where the young unopened spots were employed the cultures secured were so nearly pure that there seemed little doubt that the prevailing organism was the one responsible for the cankers. The second and third plates of a series were frequently secured containing fifty to two hundred colonies without a single contamination. The colonies do not develop at a temperature of 37° but are visible at 25° after forty-eight hours. The surface colonies are almost white at first, translucent, moist and glistening. They later become distinctly yellow and reach a diameter of one to five millimeters. The deep colonies are lenticular and darker in color. In hanging drops, the organism was found to be a small actively motile, rod-shaped form occurring singly or in pairs, or occasionally more than two together. The organism grew well in all the different kinds of culture media in which it was tried.

Cultures five days old grown upon sloped agar were used in making the inoculations. A number of young plum trees growing in pots in the greenhouse furnished the material for the inoculations. These trees bore young rapidly growing shoots a foot or more in length and the leaves were young and tender. Sterile water was added to the agar tubes and the growth removed by means of a sterile needle was completely mixed with the water, and then transferred to an atomizer and sprayed upon the young twigs. These trees were then placed in a dark room and covered with bell jars where they remained forty-eight hours. They were then removed to the green house in which the atmosphere was moderately humid and remained here throughout the experiment. Control plants were sprayed with distilled water and otherwise treated in exactly the same manner as the inoculations.

The first visible results of the inoculations was the appearance of numerous, small, water-soaked spots on the young leaves near the tip of the branches. These spots began to appear about two weeks after the inoculations were made. They soon changed in color to a purplish black and a microscopic examination revealed the presence of great numbers of bacteria within the tissue. Isolations from the leaf spots yielded pure cultures of the same organism that had been isolated from the twig cankers and sprayed upon the leaves. The leaf-spots were also apparently identical with the "shot-hole leaf-spots" of plums described by Smith[4], and caused by Pseudomonas pruni. The appearance of the water-soaked areas upon the leaves was accompanied by the development of a few upon the twigs, but they were not present here in anything like the great numbers which appeared on the leaves. They were, however, identical with the young cankers which develop in the field under natural conditions.

A number of the young twigs were next inoculated by means of punctures. A sterile teasing needle was used in making the puncture and then some of the bacteria were introduced into the wound. These plants were treated in exactly the same manner after inoculations as the sprayed plants. They were sprinkled well and kept in the dark under bell jars for forty-eight hours and then removed to the greenhouse. Control twigs were punctured, sprayed with tap water, and treated otherwise in the same manner. The punctures of control twigs, afer removal to the greenhouse, soon became dry and there was never any indication of infection. The inoculations were almost without exception surrounded by the characteristic water-soaked tissue within a few days and in due time typical cankers developed. Similar inoculations were made with young peach trees, and in this case also the punctures were almost uniformly successful.

With the successful isolation of the organism and the artificial production of the cankers by it, the question arose as to its identity. The fact that the organism is capable of producing a leaf spot that is in all ways apparently identical with the "shot-hole" spot already

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[4] Smith, Erwin F. Obervations on a hitherto unreported bacterial disease, the cause of which enters the plant through ordinary stomata. Science N. S. 17:456-457.

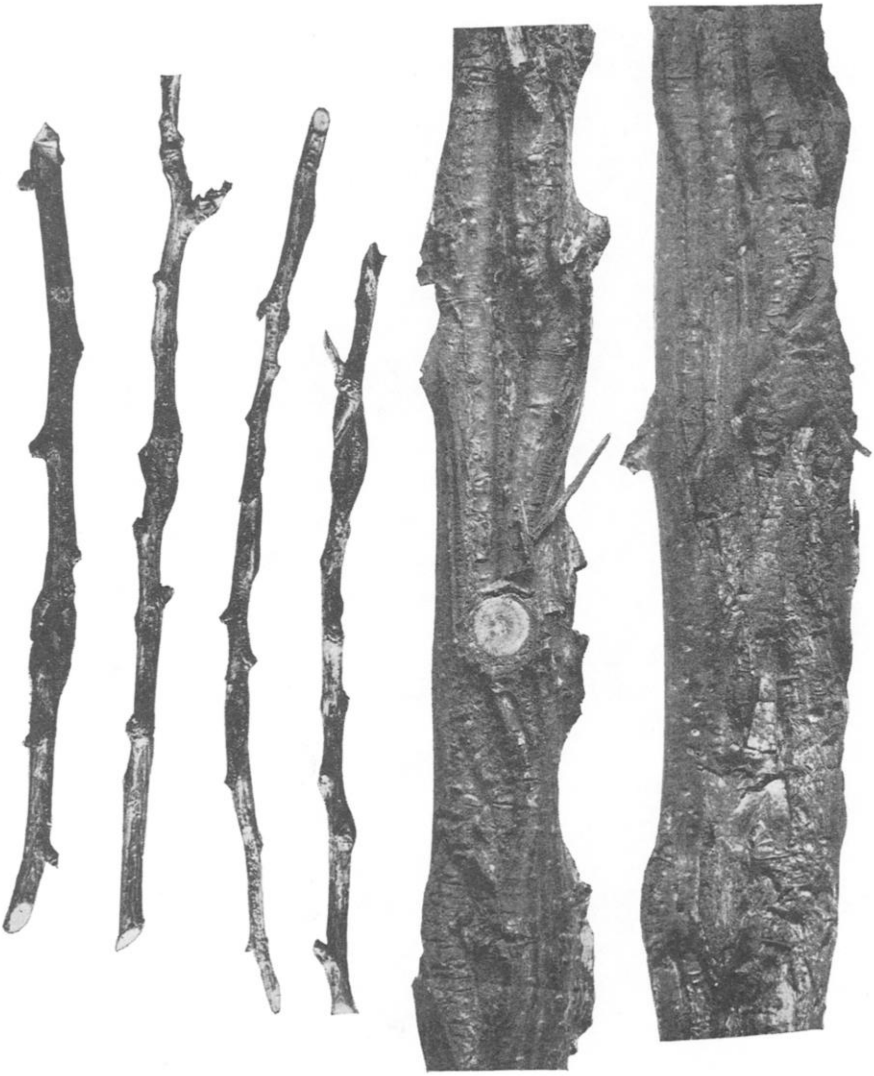

Plate XIV

Plum Cankers caused by *Pseudomonas pruni.* Twigs at left one year old; at right six years old.

widely known, suggests the probability that the organism which causes the cankers is identical with Smith's Pseudomonas pruni. The orchards from which the original isolations were made were carefully examined in order to determine the prevalence of a leaf-spot, and whether the black spot of the fruit was present or not. The shot hole spot was found to be abundant but the amount of spotting of the fruit was very slight. However, a few of the characteristic spots were found upon the fruits. Isolutions were made from both of these sources and the same yellow organism was obtained. The organism isolated from the cankers was grown side by side with these in all of the common culture media, and the fact established that they are identical. Moreover, the cultural characteristics agree in all respects with the original description of Smith for Pseudomonas pruni. I feel no hesitancy, therefore, in assigning this organism as the cause of the cankers herein described. Incidentally it has also been shown that this organism is capable of causing canker of peach trees upon cross inoculations

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